Stephen C. Petersen
Consulting Electrical Engineer
S.C. Petersen and Associates, Consulting Engineers
9629 Zayante Drive, Felton, CA 95018
831-335-3115; ac6p@arrl.net
May 3, 2004

My name is Stephen C. Petersen, and I am filing invited comments in response to NPRM 04-29 in ET Docket No. 04-37. I am a Registered Professional Engineer, currently licensed in the State of California who has practiced before the Commission on behalf of numerous Broadcast clients during the 1980's and early 1990's. Over that period I tendered, among other submission, many 301 and 302 engineering studies for both AM and FM facilities. My qualifications are a matter of record with the FCC. I am also a licensed amateur radio operator, call sign AC6P.

This letter is written primarily in response to the National Telecommunications and Information Administration (NTIA) Technical Report 04-413 issued on April 27, 2004 that outlines Part I of a two-phase study with this initial phase dealing with "interference risks to radio reception in the immediate vicinity of overhead power lines used by 'access' BPL systems."[1] . The following paragraphs comment on several pertinent issues raised in that report.

The Federal Communications Commission (FCC) is relying on the NTIA for complex RF engineering studies that should properly be anticipated and provided by the Commission's own Office of Engineering Technology (OET). NTIA is an agency funded by the Department of Commerce under the Executive Branch, while the FCC is an autonomous entity answering only to Congress. The cover letter from the NTIA Undersecretary carries the usual enthusiastic spin one would expect of an agency whose support and very existence depends on the Executive Branch, but it also implies that considerable collaboration exists between the FCC and NTIA on matters of mutual interest (WiFi, UWB and now BPL, etc.). This appearance of collaboration raises questions about the FCC's technical judgment and ability to objectively interpret and provide review of the issues contained in this study. High frequency access BPL is not merely a political, regulatory or legal issue; it is also a solid scientific one, and no amount of faith-based thinking or rhetorical posturing will alter this fact. NTIA shows that the United States presently has the highest proposed limit among current proposals in the world for regulating BPL emissions[2] principally because proponents seek to grandfather in existing Part 15 limits without careful scientific scrutiny. Among the four proposals shown, all are within approximately 20 dB of each other, while U.S.'s is approximately 40 dB above the highest of the other three:Germany NB30, Norwegian, BBC and Nato. To proceed with a rule making based on preference to employ the very high limits proposed by the U.S. without first carefully and objectively considering the methodology and criteria upon which the lower limits of the other three proposals are based is not a scientifically sound position to take. It is also a very costly decision to make considering the likely outcome of deploying BPL in the HF and low VHF spectrum prematurely.

[1] See Executive Summary NTIA at v.
[2] See NTIA fig. 3.1 at 3-5.

NTIA's response in the face of theoretically predicted and experimentally observed interference under various conditions and scenarios state that "Most studies have been oriented to determine whether interference will occur at the variously proposed limits. In contrast, NTIA has oriented its study to find a solution that accommodates BPL systems while appropriately managing the risk of interference to radio systems."[3] Thus, they advocate technologically creative ways to manage it. This statement essentially embodies the spirit of Part 15. Risk is a stochastic concept and finds enunciation in such Part 15 ideas as "infrequent radiator" or "low duty cycle" etc. I strongly caution the Commission to avoid embracing these advocates of risk management solutions as a panacea without carefully considering their viability.

Among the several suggested "interference management techniques" is selective dynamically configurable notch filtering. This is really only feasible with OFDM where the carrier separations are small enough to provide the spectral resolution required to be useful. DSSS is much more difficult to control and may be economically infeasible since the power spectral density follows an aggregate wideband $\sin x / x$ distribution based on the chipping rate and has no such analogous intrinsic fine frequency control. NTIA suggests one way to dynamically manage such interference is to listen for spectrum use and take immediate preventative measures. This is patently unrealistic. International HF broadcasts might be first detectable and then affected frequencies notched, but brief half-duplex point-to-point communications would require a station transmit *before* the nuisance carriers are deleted; this would also clearly discriminate against stations merely listening[4]. The only certain remedy is to notch *all* affected frequencies independent of whether they are "in use" or not. A far better idea is to define rules based on fixed maximum increases in the ambient signal-to-noise ratio of 0.5 to 1 dB, where the change is given by $\Delta S/N = -(N+I)/N = -10\log\left(10^{0.1(I/N)}+1\right)$ with $(N+I)/N = 0.5$ or $1.0dB$ [5].

The NTIA study also shows that measurement methods need to be changed to insure compliance with radiation limits. I agree generally with the 10 meter elevation and 10 meter horizontal distance from MV lines, but assert that measurements need to be taken for both the electric and magnetic field intensities when in the near-field. This is already required as a matter of standard practice in radio frequency radiation hazard (RFR) survey measurements, where large analytically unpredictable differences can exist between these two fields that do not ratio to 377 Ohms. Moreover, both NTIA[6] and Ameren[7] are theoretically incorrect in stating that the intrinsic impedance of free space varies in the near field. The intrinsic impedance of free-space in a vacuum (or in air which differs by much less than 1%) is and always will be precisely $\eta = \sqrt{\frac{\mu_\circ}{\varepsilon_\circ}} \simeq 377\Omega$ to three significant figures, where $\mu_\circ$ (permeability) and $\varepsilon_\circ$ (permittivity) are invariant properties of free space. This follows from a solution to Maxwell's equations, applies next to any antenna or passive re-radiating structure in the near field, transition field or far field. In the far field, electric and magnetic fields time-harmonically (i.e.,

[3] See comments of NTIA at 3-12.
[4] See comments of NTIA at 2-6.
[5] See discussion by NTIA in section 6.3, *Risk Evaluation Criteria,* equations *6-1,2,3.*
[6] See comments of NTIA at §7.8 at 7-5.
[7] See comments of NTIA at 3-7.

sinusoidally) create each other by passing *the same* energy back and forth in time-phase between them as the plane wave they comprise propagates at a velocity of $c = \frac{1}{\sqrt{\mu_\circ \varepsilon_\circ}} = 2.998 \times 10^8$ or meters per second. Therefore the ratio of the electric (E) field intensity to the magnetic (H) field intensity must equal 377 Ohms. But in the near field E and H also have superimposed components created by the electric potentials on the antenna and nearby re-radiating structures along with the current flowing in them. These so-called inductive fields represent oscillating energy alternately returning to the antenna each RF cycle in much the same way an inductor or capacitor alternately sinks and sources energy with the net zero being power. These components are not in time-phase and do not represent radiated energy and thus won't ratio to 377 ; they also decrease with the square or cube of increasing distance. From a practical standpoint, this will necessarily be complicated by the fact that victim receivers in the near field of MV radiators will experience complicated out of phase E and H field intensities. NTIA may have sufficient simulation data from their NEC runs to determine whether measurements need to be taken for both fields or rely on the one that can be shown to reliably dominate in particular near-field physical situations, since NEC output also is capable of providing this wanted near field information. In the absence of a good model – which may well be the case, I suggest this situation be treated conservatively exactly the way we treat such situations in current RFR practice: measure both fields. This requires further investigation.

On December 1, 2003, Corridor Systems sent "An open Letter to the FCC Regarding the ARRL's Submissions to Notice of Inquiry, FCC 03-100"[8]. Corridor alluded to tests in the 2.4 and 5.2GHz ISM bands apparently utilizing proprietary technology capable of using overhead power lines to conduct surface wave mode electromagnetic energy without appreciable attenuation or unacceptable incidental radiation. If this is true, and the technology viable, why hasn't this been mentioned during these "HF" BPL proceedings at least as a *rational* alternative? I strongly support new technology and the concept of access BPL generally. But using the HF and low VHF spectrum to realize the wanted "last mile" when alternate emerging technology may exist that cleanly accomplishes the same thing at microwave frequencies just makes good scientific and public policy sense, since apparently it is able to meet interference goals that HF BPL in its present form simply cannot. This technology needs to be reviewed and carefully considered before rushing into deployment of what amounts to very expensive, in terms of enforcement and compliance, newly created but federally managed spectral pollution.

Sincerely,
Stephen C. Petersen, P.E.

[8] Available on Corridor Systems website, www.corridor.biz/031201-fcc-letter.pdf